A Data Acquisition Method of a Non-Real Time Transmitting

Seismic Data Acquisition System Applied in Mountainous Areas

BACKGROUND OF THE INVENTION

~~TECHNICAL FIELD~~ Field of the Invention

This invention relates to the fields of petroleum seismic exploration, geology, acquisition of seismic data for ~~coalmine~~ coal mine resources, and ~~detecting~~ earthquake detection.

~~BACKGROUND OF THE TECHNOLOGY~~ Related art

Following the development of the technology of geophysical exploration, seismic prospecting is directed towards ~~to~~ higher mountainous regions in which it is more difficult to work and all remote transmission seismic apparatuses of real time ~~transmitting~~ transmission by ~~cables/wireless~~ cable/wireless have had ~~has~~ more and more ~~difficult to~~ difficulty meeting the requirements of practical prospecting.

For example, remote transmission seismic apparatuses ~~by~~ using cables ~~need to~~ entail carrying large ~~big~~ bundles of cables to ~~cliffy~~ mountains cliffs. This results in the ~~a great amount~~ use of a great amount of labor ~~labour power~~ and transporting equipment, ~~being~~ is very dangerous, and frequently results in ~~frequently happening of~~ casualties[[,]] and damage[[s]] ~~of~~ to the equipment. In addition, it is frequently impossible to deploy cables to a designed position as a result of the limitation ~~of the~~ in length of the cables, so that channels [[are]] may be emptied or lost.

Although a remote transmission seismic apparatus ~~by~~ using wireless ~~transmitting~~

transcription is convenient, the system usually loses channels and/or stations in a mountainous regions as a result of the blind regions of radio transmission. The workload is increased because the great amount of ~~very much~~ electric energy consumed by wireless transmission needs heavy ~~equipment of~~ power supply equipment. The efficiency of the deployment of wireless remote transmission seismic apparatuses decreases ~~is lower and lower~~ along with the increase of channels deployed because more ~~long~~ time is needed for the real time data return transmission. The aforementioned ~~above~~ two kinds of seismic apparatuses have had ~~been~~ very much difficulty ~~to~~ meeting the needs of the ~~fieldwork~~ field when the ~~working~~ is in mountainous areas with very bad topography.

The applicants have invented remote transmission seismic apparatuses using GPS (Global Positioning System) satellite timing, which has "no central units (main seismometer), no cables, and no radio stations, and is portable, cheap, and ~~intelligentized~~ intelligent" (~~The~~ the application numbers of those Chinese patents are CN01134726.0 and CN02129603.0) for compensating for the shortage of real time transmitting seismic apparatuses in ~~the art in~~ the fields of system conveying, arrangement of ~~arranging~~ cables for prospecting, data transmission, and communication. The remote transmission seismic apparatuses using GPS satellite timing are especially suitable to seismic prospecting work in complicated because the apparatus has two ~~kinds~~ manners of working, ~~one is~~ timing data acquisition[[,]] and ~~the other is~~ continuous data acquisition, so that the working efficiency of seismic data acquisition in [[the]] those fields is increased and the cost is decreased.

The non-real time transmission seismic data acquisition apparatus uses high accuracy GPS clock signals to ~~synchronise~~ synchronize the system clocks of every acquisition unit and

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remote detonating unit, and works by way in the ways of timed and synchronised synchronized detonating and recording. In operation, the detonating and recording units[[,]] all operate according to a flow chart designed for the system without any artificially intervention. If the system operates 12 hours every day and acquires and records data for every minute, the numbers of original record files in every data acquisition unit every day are equal to 12 x 60, i.e., 720 original record files every day. If the system operates 12 hours every day and acquires and records data for every ten-second ten seconds, the numbers of original record files in every data acquisition unit every day are equal to 12 x 60 x 6, i.e., 4320 original record files every day. The number[[s]] of original files in the data acquisition units increase are more and more as the number of data acquisition units and the data acquisition time increase (i.e., increase by degrees of geometric series). Therefore, whether or not the present system is capable of being applied in practice, the key points are how to manage and safely retrieve these original record files.

SUMMARY OF THE INVENTION

The data acquisition method of a non-real time transmitting seismic data acquisition system applied in mountainous areas of this invention may solve the following technical problems in a non-real time transmitting seismic data acquisition system, and can [[:]] [[the]] safely and effectively managing of manage tens of thousands original record files, intelligentized intelligently retrieving retrieve record files in the acquisition unit, and permuting permute the data after retrieving it.

The data acquisition method of a non-real time transmitting seismic data acquisition system applied in mountainous areas of this invention is as follows has the following features:

(1)   using the eight digit[[s]] file names representing absolute time together with three digit[[s]] extension names representing equipment serial names as the format of original record file names, wherein the eight digit[[s]] file names and three digit[[s]] extension names consisting of Arabic numerals 0-9 and English letters;

(2)   all original record files names in the data acquisition unit [[being]] are 8 + 3 digit[[s]] file names and consist[[ing]] of Arabic numerals 0-9 and English letters; the former eight digits represent[[ing]] years, months, days, hours, minutes, and seconds; and the latter three extension name[[s]] digits represent[[ing]] the equipment's serial number of data acquisition units;

(3)   the detonating units generating generate SPS format (Shell's Processing Support Format) spreadsheets of 3-D land seismic exploration assistant data according to file names generating the method of the step (1), and at the same time, it is appointed that by means of distinguishing intermittence signals generated by the high voltage circuits in the detonating units, thee operating systems in the detonating units write the effective explosion's absolute operating time into SPS format spreadsheets of 3-D land seismic exploration assistant data according to the detonating unit's file names generating method when there are intermittence signals, and does not record the said absolute operating time in SPS format spreadsheets of 3-D land seismic exploration assistant data when there are no intermittence signals;

(4)   combining the multiple detonating unit's SPS format spreadsheets of 3-D land seismic exploration assistant data according to SPS format spreadsheets of 3-D land seismic exploration assistant data, which are generated by the multiple detonating units to prepare for retrieving the data; while retrieving, inputting the combined multiple detonating unit's SPS

format spreadsheets of 3-D land seismic exploration assistant data into the data retrieve units, which consist of microprocessors with system bus. [[;]]

The above file names are effectively recorded in SPS format spreadsheets of 3-D land seismic exploration assistant data ~~being~~ on the basis of the former eight digits; connecting the data acquisition units and the data ~~retrieve~~ retrieval units by net<u>work</u> lines ~~in the way of network~~; operating the data retrieving ~~programmes~~ programs in the data ~~retrieve~~ retrieval units; connecting the data ~~retrieve~~ retrieval units and the data acquisition units with a special line; <u>and</u> running the data retrieving ~~programmes~~ programs to complete the following operations:

a)   searching the original files effectively recorded in the field acquisition units and copying them into the data ~~retrieve~~ retrieval units;

b)   setting the original files as read-only attribute<u>s</u> on the disks of computers in the field acquisition units to prevent <u>loss of</u> ~~to lose the~~ data, <u>so that</u> ~~and in that case,~~ the data can be retrieved again; <u>and</u>

c)   ~~Deleting~~ deleting the great amount of unnecessary data to release <u>disk</u> ~~the~~ space ~~of the disks so as~~ to prepare for the next acquisition; [[.]]

(5)   arranging the data sequences indoors after the data retrieving operations; rearranging the original ~~files~~ data <u>files</u> effectively recorded in the multiple data ~~retrieve~~ retrieval units into the format recorded in the unit of shots according to "the regulations of the same file names" on the basis of <u>the</u> layout to provide to the system of processing data.

~~As hereinabove~~ <u>In</u> the data acquisition method of <u>a</u> non-real time transmitting seismic data acquisition system applied in mountainous area<u>s</u>, when the generation of original file names recorded in the data acquisition units are recorded once for every minute, the former eight digits

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have the following meaning: the first digit of the former eight digits represents years and consists of Arabic numerals and English letters, and is circularly used again and again for 36 years; the second digit represents months and consists of Arabic numerals, and is denoted according to the practical calendar; the fifth and the sixth digits represent hours and consist of Arabic numerals, and is denoted according to the 24 hour[[s]] system; and the seventh and the eighth digits represent minutes and consist of Arabic numerals, and is denoted according to the ~~the~~ 60 minute[[s]] system.

~~As hereinabove~~ In the data acquisition method of a non-real time transmitting seismic data acquisition system applied in mountainous areas, when the generation of original file names recorded in the data acquisition units are recorded once for every ten-seconds, the former eight digits have the following meaning: the first digit of the former eight digits represents years and consists of English letters, and is circularly used again and again for 26 years; the second digit represents months and consists of Arabic numerals and English letters; the third digit represents days and consists of Arabic numerals and English letters, and is denoted according to the practical calendar; the fourth and the fifth digits represent hours and consist of Arabic numerals, and is denoted according to the 24 hour[[s]] system; the sixth and the seventh digits represent minutes and consist of Arabic numerals, and is denoted according to the 60 minute[[s]] system; and the eighth digit represents seconds; and every ~~ten-second~~ ten seconds is used as a measure unit.

~~As hereinabove~~ In the data acquisition method of a non-time transmitting seismic data acquisition system applied in mountainous areas, wherein the extension names of the detonating units are ._XX, which denote the serial number of ~~making~~ the detonating units, and the latter two

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digits after the underscore ~~underline~~ consist of Arabic numerals 0-9 and English letters, which are permuted and combined.

This invention has the following advantages and positive effects in comparison with the traditional seismic data acquisition methods. [[:]]

It is ~~realised~~ realized to manage the original file data recorded in the data acquisition units effectively and safely by means of the original record file data acquisition method of a non-real time transmitting seismic data acquisition apparatus. The method is exclusive and feasible to manage and search and has solved the technically difficult problems of the data management for original record files and the difficulties of retrieving data as result of non-real time transmitting characteristics of the system. The method may find the original file data (effective data) recorded in the every field data acquisition unit quickly and accurately and delete the unnecessary data acquired. The method ~~realises~~ realizes the safe and ~~intelligentized~~ intelligent management of the original record file data of a non-real time transmitting seismic data acquisition apparatus to provide a safe and reliable managing mechanism for permuting and arranging the data at the latter time.

The present invention may be ~~intelligentized~~ made intelligent without any artificial[[ly]] intervention if otherwise ~~equipping~~ equipped with [[the]] special software and equipment for automatically permuting the data indoors so that this invention can also completes the whole process of seismic data acquisition in the field completed by the conventional real time data acquisition system.

~~DETAILED~~ BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of the circuits of the data ~~retrieve~~ retrieval unit according to the invention;

FIG. 2 is a flow chart of the operation of the data acquisition units according to the invention;

FIG. 3 is a flow chart of the operation of the detonating units according to the invention;

FIG. 4 is a flow chart of the operation of the data ~~retrieve~~ retrieval units according to the invention;

FIG. 5 is a flow chart of the operation of permuting the data indoors according to the invention;

FIG. 6 is a block diagram of the structure of the detonating unit system according to the invention; and

FIG. 7 is a block diagram of the structure of the data acquisition unit system according to the invention. [[;]]

~~EMBODIMENTS~~ DETAILED DESCRIPTION OF THE ~~INVENTION~~ PREFERRED EMBODIMENTS

The modes and steps of embodying the invention in detail are as follows:

1.   The format of the file names of the original record files are eight digit[[s]] file names together with three digit[[s]] extension names which consist of Arabic numerals 0-9 and English letters, i.e., XXXXXXXX.XXX.

The former eight file name[[s]] digits represent absolute time.

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The latter three extension name[[s]] digits represent the ~~equipment's~~ serial number of the equipment.

2. The regulations of generating file names of the data acquisition units.

The meanings of eight digits together with three digit[[s]] file names.

(A) The meaning of XXXXXXXX while recording once for every minute:

The first digit represents years and consists of Arabic numerals and English letters, and is circularly used again and again for 36 years. It is appointed that the number 0 represents the ~~2000~~ year 2000, the number 1 represents the ~~2001~~ year 2001, the number 9 represents the ~~2009~~ year 2009, the letter a represents the ~~2010~~ year 2010, the letter b represents the ~~2011~~ year 2011, ... , and so on. [[,]] ~~the rest may be deduced by analogy~~.

The second digit represents months and consists of Arabic numerals and English letters. It is appointed that the number 1 represents January, the number 9 represents September, the letter a represents October, the letter b represents November, and the letter c represents December.

The third and fourth digits represent date and consist of Arabic numerals, and are denoted according to the practical calendar. It is appointed that the numbers 01 represent the first day in the calendar, and the numbers 31 represent the thirty-first day in the calendar.

The fifth and sixth digits represent hours and consist of Arabic numerals, and are denoted according to the 24 hour[[s]] system. It is appointed that the numbers 00 represent 0 o'clock ~~at the~~ midnight, the numbers 01 represent 1 o'clock a.m., ... , and the numbers 23 represent 23 o'clock p.m..

The seventh and eighth digits represent minutes and consist of Arabic numerals, and are denoted according to the 60 minute[[s]] system. It is appointed that the numbers 00 represent zero minutes, the numbers 01 represent one minute, ..., and the numbers 59 represent fifty-nine minutes.

Hence, for example, 3a231834.XXX represents the seismic records received (or the existent shooting) at eighteen o'clock thirty-four p.m. sharp on October 23rd, 2003.

(B) The meaning of XXXXXXXX while recording once for every ten-seconds:

The first digit represents years and consists of English letters, and is circularly used again and again for 26 years. It is appointed that the letter a represents the 2001 year 2001, the letter b represents the 2002 year 2002, the letter c represents the 2003 year 2003 £......£and so on; and the rest may be deduced by analogy.

The second digit represents months and consists of Arabic numerals and English letters. It is appointed that the number 1 represents January, the number 9 represents September, the letter a represents October, the letter b represents November, and the letter c represents December.

The third digit represents days and consists of Arabic numerals, and is denoted according to the practical calendar. It is appointed that the number 1 represents the first day in the calendar, ..., the number 9 represents the ninth day in the calendar, the letter a represents the tenth day in the calendar, the letter b represents the eleventh day in the calendar, ..., and the letter v represents the thirty-first day in the calendar.

The fourth and fifth digits represent hours and consist of Arabic numerals, and are denoted according to the 24 hour[[s]] system. It is appointed that the numbers 00 represent 0 o'clock at the midnight, the numbers 01 represent 1 o'clock a.m., and the numbers 23 represent 23

o'clock p.m..

The sixth and seventh digits represent minutes and consist of Arabic numerals, and are denoted according to the 60 minute[[s]] system. It is appointed that the numbers 00 represent zero minutes, the numbers 01 represent one minute,......, and the numbers 59 represent fifty-nine minutes.

The eighth digit represents seconds. Every ten-second <u>unit</u> is used as a measure unit. It is appointed that the number 0 represents 00 second, the number 1 represents 10 seconds,......, and the number 5 represents 50 seconds.

Hence, for example, cau18343.XXX represents the seismic records received (or the existent shooting) at eighteen o'clock thirty-four and thirty seconds p.m. sharp on October 30th, 2003.

The above two methods of managing files are distinguished by the first digit representing the years[[:]] <u>before</u> 2009 ago, the former consists of Arabic numerals, and the latter starts with the English letters; <u>for the years</u> after 2009, the difference between them is nine years so that <u>there can be no</u> the confusion with each other can not happens. Therefore, the file name is still "exclusive".

3.   The meaning of three extension names

(1)   The three extension names of the data acquisitions units. XXX represent the equipment's serial number of the data acquisition units and consist of the permutation and combination of the Arabic numerals 0-9 and English letters. It is denoted that the first equipment is numbered as 001, 999 represents the product[['s]] serial number of the 999th equipment, 00a represents the product[['s]] serial number of the first thousandth equipment, ..., and so on; [[,]]

the rest may be deduced by analogy.

This nomenclature may generate $36^3 = 46656$ names of the equipment. These names are enough to manage 139968 seismic traces.

(2)   The extension names of the detonating units are ._XX, denote the detonating unit's serial number, and consist of one underscore ~~underline~~ and two characters. The two digits XX ~~are~~ consist of the permutation and combination of the Arabic numerals 0-9 and English letters

4.   The generation method of the operation files of the detonating units

The detonating unit consists of GPS receiving sections, industrial microcomputers, high voltage circuits, and A/D conversion circuits. The output of the high voltage circuits is connected to detonating ends of electric detonators. The operating systems in the detonating units operate by means of distinguishing intermittence signals generated by the high voltage circuits in the detonating units. When there are intermittence signals, the detonating units write the effective explosion's absolute operation time into SPS format spreadsheets of 3-D land seismic exploration assistant data according to the methods of generating file names of the detonating units; and when there are no intermittence signals, the detonating units do not record the ~~said~~ absolute operation time into SPS format spreadsheets of three dimensions seismic exploration assistant data. The SPS format spreadsheets of 3-D land seismic exploration assistant data are generated according to the generation methods of file names of the detonating units when the detonating units are operating, and at the same time, it is appointed that the effective explosion's absolute operation time is written into the SPS format spreadsheets of 3-D land seismic exploration assistant data according to the generation methods of file names of the detonating units only

when the detonating units detonate the explosive successfully, and when the operations are off and the detonation of the explosive is not successful, the absolute operation time is not recorded into the SPS format spreadsheets of 3-D land seismic exploration assistant data.

5. The ~~intelligentized~~ intelligent retrieving of the data

The ~~intelligentized~~ intelligent retrieving of ~~retrieving~~ data is an application on the basis of the original record file data acquisition methods of <u>a</u> non- time transmitting seismic data acquisition apparatus. First of all, the SPS format spreadsheets of 3-D land seismic exploration assistant data of multiple detonating units are combined according to the SPS format spreadsheets of 3-D land seismic exploration assistant data generated by the detonating units so as to prepare for retrieving the data.

When retrieving, the combined SPS format spreadsheets of 3-D land seismic exploration assistant data of the detonating units are put into the special data retrieve units. The data acquisition units and the special data retrieve units are connected by net lines in the form of <u>a</u> network according to the file names (the former eight digits) effectively recorded in the SPS format spreadsheets of 3-D land seismic exploration assistant data while the detonating units are operating. The ~~programes~~ <u>programs</u> of ~~intelligentized retrieving~~ <u>intelligent</u> data <u>retrieval</u> are run in the special data retrieve units. The field operators only connect the plugs of the special data retrieve units to the special plugs of the data acquisition units and initiate ~~intelligentized~~ <u>an</u> <u>intelligent</u> retrieve ~~programmes~~ <u>program</u> system so that the following operations are completed automatically:

1. According to the principles of "the same file names", the original effective file data recorded in the data acquisition units are searched and copied to the data retrieve units.

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2. The original effective file records are set as read-only attributes on the disks of the computer[[s]] disks of the data acquisition units to prevent loss of to lose the data; [[,]] if the data would be lost, the data can also be retrieved.

3. The great amounts of unnecessary data acquired are deleted to release the disk space of the disks so as to prepare for the next recording.

The above data acquisition units consist of GPS receiving sections, industrial microcomputers, and A/D conversion circuits.

ABSTRACT OF THE DISCLOSURE

~~This invention discloses a~~ A data acquisition method of a non-real time transmitting seismic data acquisition system applied in mountainous areas. [[the]] The format of original record file names is an 8 digit[[s]] file name representing absolute time together with 3 digit[[s]] extension names representing the equipment's serial number. The detonating units generate SPS format spreadsheets according to the above file name generation method. SPS format spreadsheets of several detonating units are combined on the basis of the SPS ~~fotormat~~ format spreadsheets generated by every detonating unit and then put in a data ~~retrieve~~ retrieval unit. The effective file names, which are recorded in the SPS format spreadsheets while detonating units are operating, are based on the former 8 digits. The acquisition unit and the data ~~retrieve~~ retrieval unit are connected by network lines, and a data retrieving program will run by the data ~~retrieve~~ retrieval unit. This method is exclusive and feasible to manage and search the seismic data. The method solves the technically difficult problems of [[the]] data management for original record files and the difficulties of retrieving data as result of non-real time transmitting characteristics of the system.